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Title:	New Data Library for MCNP Delayed Neutron Capability
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memorandum

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SUBJECT: New Data Library for MCNP Delayed Neutron Capability

A new MCNP data library has been created, appending ENDF/B-VI delayed neutron data to the existing ENDF60[1] data tables. This library is intended for use with a newly modified version of MCNP4B (to be documented in a later report) that more accurately represents the secondary neutrons produced from a fission event. This is accomplished by incorporating the capability of calculating the probability of delayed neutrons and, if sampled, their energy and time of creation after the occurrence of a fission event.

The status of delayed neutron data as well as the total and prompt information available from ENDF/B-VI is summarized in Table 1 for each fissionable nuclide. From Table 1 it can be seen that there are 23 isotopes in ENDF/B-VI that contain complete delayed neutron data. The ENDF/B-VI data libraries for each of these 23 isotopes were obtained from the T-2 web-site http://T2.lanl.gov/cgi-bin/nuclides/endind, and are listed in Table 2. The delayed data obtained were from ENDF/B-VI evaluations consistent with those originally used for ENDF60; the ENDF/B-VI release number is also listed for each isotope on Table 2.

These delayed neutron data were next merged with the existing MCNP data table, from ENDF60, using the stand alone utility code MERGE.F, reported in XCI:CJW-98-123(U) and available on CFS in the directory /x6data/working/delayed/. This code reads in the ENDF formatted isotopic data file, along with the MCNP data library. It then adds to the neutron production section of the data library file the ENDF/B-VI delayed neutron data for that isotope and corrects the JXS and NXS arrays. The modified version of MCNP4B requires the delayed neutron data in the format specified in XCI:CJW-98-121(U), which MERGE.F creates. Since ^{237}U, ^{238}Np, and ^{242}Am are not available on ENDF60, no modified files were created for these isotopes. A new library, called ENDF6DN, has now been constructed consisting of the 20 isotopes listed in Table 2 and having ZAIDs with the extension .61c. The only difference between the corresponding files with ZAID extensions of .60c and .61c is the addition of the delayed neutron data, and therefore, these files are identical in all other places.

This MCNP data library is now ready to be used with the modified MCNP4B version. Type 1 and type 2 libraries (and directories) can be found on CFS at /x6data/ce/special/delayed/.

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[1] LA-12891

Table 1 – Total, prompt and delayed fission data available from ENDF/B-VI.

Element	Isotope	Total Nubar (Format)	Delayed Nubar (Format)	Prompt Nubar (Format)	Total/Prompt Energy Distribution	Delayed Energy Distribution
Th	230	Polynomial	-------	-------	7	-------
	232	Table	Table	Table	11	5
Pa	231	Table	Table	Table	11	5
	233	Polynomial	-------	-------	7	-------
U	232	Table	Table	Table	7	5
	233	Table	Table	Table	11	5
	234	Table	Table	Table	7	5
	235	Table	Table	Table	Table	5
	236	Table	Table	Table	7	5
	237	Table	Table	Table	7	5
	238	Table	Table	Table	11	5
Np	237	Table	Table	Table	Table	5
	238	Table	Table	Table	7	5
	239	Polynomial	-------	-------	7	-------
Pu	236	Polynomial	-------	-------	7	-------
	237	Polynomial	-------	-------	7	-------
	238	Table	Table	Table	7	5
	239	Table	Table	Table	Table	5
	240	Table	Table	Table	7	5
	241	Table	Table	Table	7	5
	242	Table	Table	Table	7	5
	243	Table	-------	-------	7	-------
	244	Polynomial	-------	-------	7	-------
Am	241	Table	Table	Table	7	5
	242	Table	-------	-------	7	-------
	242ma	Table	Table	Table	7	5
	243	Table	Table	Table	7	5
Cm	241	Polynomial	-------	-------	7	-------
	242	Table	Table	Table	7	5
	243	Polynomial	-------	-------	7	-------
	244	Polynomial	-------	-------	7	-------
	245	Table	Table	Table	7	5
	246	Polynomial	-------	-------	7	-------
	247	Table	-------	-------	7	-------
	248	Polynomial	-------	-------	7	-------
Bk	249	Table	Table	Table	7	-------
Cf	249	Table	Table	Table	7	5
	250	Table	-------	-------	7	-------
	251	Table	Table	Table	7	5
	252	Table	-------	-------	7	-------
	253	Polynomial	-------	-------	7	-------

LF:11 = Watt Spectrum
LF:7 = Maxwellian Spectrum
LF:5 = General Evaporation Spectrum

Table 2 – Material, ZAID from ENDF60 library, new ZAID for ENDF6DN, the evaluation and version of delayed neutron data placed in the ENDF6DN data files.

Material	ZAID from ENDF60	New ZAID for ENDF6DN	Evaluation	Release
^{232}Th	90232.60c	90232.61c	BNL,ANL+	-
^{231}Pa	91231.60c	91231.61c	HEDL	-
^{232}U	92232.60c	92232.61c	HEDL	-
^{233}U	92233.60c	92233.61c	LANL,ORNL	-
^{234}U	92234.60c	92234.61c	BNL,GGA+	-
^{235}U	92235.60c	92235.61c	KAPL,ORNL,LANL+	r2
^{236}U	92236.60c	92236.61c	HEDL	-
^{238}U	92238.60c	92238.61c	ORNL,LANL+	r2
^{237}Np	93237.60c	93237.61c	LANL,HEDL	r1
^{238}Pu	94238.60c	94238.61c	HEDL,AI+	-
^{239}Pu	94239.60c	94239.61c	LANL,ORNL+	r2
^{240}Pu	94240.60c	94240.61c	ORNL,LANL	r2
^{241}Pu	94241.60c	94241.61c	ORNL	r1
^{242}Pu	94242.60c	94242.61c	HEDL,SRL+	-
^{241}Am	95241.60c	95241.61c	CNDC	r2
^{243}Am	95243.60c	95243.61c	LANL,ORNL	-
^{242}Cm	96242.60c	96242.61c	HEDL,SRL+	-
^{245}Cm	96245.60c	96245.61c	SRL,LLNL	r2
^{249}Cf	98249.60c	98249.61c	CNDC	-
^{251}Cf	98251.60c	98251.61c	BNL,SRL+	r2

- Release 0 of ENDF/B-VI